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ABSTRACT

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Repeated Testing During Acquisition of College Course Material

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Abstract

Two experiments investigated the acquisition of course material under conditions of repeated testing. In Experiment I, with limited study intervals, acquisition increased over trials of study followed by testing. In addition, adjunct information about the content of the test item pool also increased performance. In Experiment II, with student determined study intervals, there was little or no change in performance associated with repeated testing.

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A common practice of introducing an assigned instructional passage is the one-shot opportunity in which a single study interval is followed by a test. Under conditions of repeated testing, at minimum, a second study interval is introduced and is followed by a test; that is, a second acquisition trial is introduced (cf., Jensen and Prosser, 1969). In the present studies an instructional passage was selected and for this passage a large pool of test items was constructed to measure learning. With the help of a computer a large number of tests were constructed, each of which consisted of a random sample of test items from the pool. Each student was then given a different one of these tests during acquisition on each trial.

Experiment I

The main purpose of this experiment was to study acquisition under conditions of repeated testing. An instructional passage was available for study only in a study room. On each trial the students would come to the room, study the passage for a two hour period, and then take one of the tests on the material. The available study interval on each trial, therefore, was fixed at two hours. The amount of actual study time cannot be determined, of course, but was probably less than the available study interval. This procedure was repeated four times for a total of five acquisition trials according to an intertrial interval schedule which each student prearranged prior to the first trial. It was expected that as the number of study trials increased, the amount of learning would increase.

A second purpose of this study was to determine the effects of the amount of information given to students about the content of the test item pool on acquisition. All of the test items were generated by applying a single rule to the instructional passage. Therefore, all items in the pool from which the tests were constructed could be said to represent the same item type (Anderson, 1970; Bormuth, 1970; Schlesinger and Weiser, 1970). In the No Information (NI) condition, no information adjunct to the instructional passage was given to students about the content of the item pool from which the tests would be constructed. In the Rule Information (RI) condition students were given a statement of the rule that was used to generate the test items in the pool from which their tests would be constructed. Illustrations of the use of the rule were also given. In the Question Information (QI) condition students were given the actual test items which comprised the pool from which their tests would be constructed. These conditions representing the amount of information given about the content of the test item pool seemed similar to procedures which provide encoding cues such as objectives and underlining to increase learning (cf., Crouse and Idstein, 1972). Acquisition was expected to increase over conditions NI, RI, and QI, respectively.

Method. The article by Campbell (1969) entitled "Reforms as Experiments" was chosen from the reading materials of a course in Educational Research Procedures. A 117 question test item pool was constructed by applying the following rule 117 times throughout the passage: a sentence was taken directly from the passage and expanded, if necessary, to include words obviously understood from the context of the passage but not included in the sentence. From this expanded sentence, a portion was identified, and a WH-question was derived to question this portion (cf., Bormuth, 1970, for descriptions of item-writing procedures). From the pool of 117 test questions, a large number of 21 item tests were constructed by a computer program which randomly sampled 21 items for each test from the pool of 117 items. Five acquisition trials were given under each of the three information conditions; therefore, the design was a 5X3 factorial with repeated measures on the first factor. Fourteen masters-level students enrolled in the course in Educational Research Procedures at the University of Delaware were randomly assigned to each of the three information conditions. No mention was made at any time that an experiment was being conducted.

Results. The results indicated that an increased number of acquisition trials resulted in large increases in learning of the course material ($F = 55.42$, $df = 4/156$, $p < .01$). They also showed that increased information about the content of the test item pool facilitated performance ($F = 14.74$, $df = 2/39$, $p < .01$). Almost all of this increase occurred when students were given the actual items from which their tests would be constructed (Condition QI), with no apparent effect being seen when a rule was given by which the test items would be constructed (Condition RI). These results add further support to the principle that under circumstances where conditions adjunct to reading materials can plausibly be assumed to influence encoding of information required by output that would not otherwise be encoded, output performance will be facilitated (cf., Crouse and Idstein, 1972).

Experiment II

The results of Experiment I indicated that as the number of study trials increased, acquisition increased. Another way to say this is that students were motivated to do more learning than they would achieve on the early trials. This implies that the beneficial effects of repeated testing resulted from the use of a study interval as short as two hours on each trial which restricted the amount of learning that could occur. Experiment II tested this possibility. Students were given the reading material and they could take it home to study at their convenience. When they wanted to, they could come to the study room and take one of the tests on the reading. In this setting the available study interval was student determined by the length of time before they came in to be tested. The amount of actual study time which occurred during this period was estimated by having each student keep a detailed record of his study. After being tested the students could again take the passage for a second study interval, study as much as they wanted, and then come for testing. A total of four acquisition trials could be completed in this fashion; the number each student completed was left optional.

Method. The materials were the same ones used in Experiment I; that is, the article by Campbell (1969) entitled "Reforms as Experiments", the 117

question test pool, and the batch of 21 question tests each comprising a random sample of 21 questions from the question pool. All students in the experiment were again enrolled in the course in Educational Research Procedures, and again no mention was ever made of an experiment being conducted. Studying could be done anywhere and each student was asked to record, to the minute, each starting and stopping time. When ready, the students could come for testing at which time they were given one of the tests with unlimited time for its completion. After completing the tests they could undertake additional study and follow it with testing. Up to four trials could be completed in this fashion. Fifty-three students participated in this study-learning procedure.

Results. As expected, most students completed all four acquisition trials; the number completing one, two, three, and four trials was 5, 6, 6, and 36, respectively. Because the number was substantial for only the four trial group, subsequent analyses were done on these data. The number of correct answers on each acquisition trial was computed and performance was found to first increase slightly and then decrease slightly over trials. While the analysis of variance revealed a significant F for these changes ($F = 9.27$, $df = 3/105$, $p < .01$), the overall magnitude of the changes was very small; that is, always less than 2.5 correct answers out of a possible 21. It is as if the potentially unlimited study intervals, in contrast to Experiment I, allowed the students to do as much learning as they wished to do on trial 1, and with added trials they were unwilling to do more.

The question arises as to the relationship between study time and acquisition. The actual time spent studying was available for each student on all four acquisition trials. Since the greatest variability in study times was on the first trial, this first trial data seemed most likely to reveal any correlation which existed between study time and performance. Unexpectedly, there was no sign of a positive correlation; $r = .10$, $df = 34$, $p > .05$). One explanation for this failure to find a positive relationship is that study time is negatively correlated with ability, which in turn is directly related to correct performance. Consequently, any positive relationship between study time and performance would be masked by ability differences. The data supported this interpretation. The correlation between study time and ability (verbal scores on the Graduate Record Examination) was in the right direction and significant ($r = -.50$, $p < .01$) and the correlation between ability and correct performance was also in the right direction but fell short of significance ($r = .30$, $p < .10$). Most importantly, however, when differences in ability were partialled out, the correlation between study time and correct performance was positive and significant ($r = .42$, $p < .01$).

Discussion

The results of both experiments lend further support for the importance of study time as a determiner of learning. In Experiment I with limited study intervals, study time increased over trials as did acquisition. In Experiment II with potentially unlimited study intervals, there was little increase in acquisition beyond trial 1, but on trial 1 study time was found to be positively

related to performance after differences in study ability were partialled out. It seems that repeated testing in its barest form used in the present studies is important primarily as a way of increasing study time when the study intervals are less than optimal to achieve desired learning. If study time can be increased by other means, little or no advantage may be found for repeated testing, at least as used in the present studies.

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